



***TYPE 1***  
***SURVEILLANCE***  
***MANUAL***

***Version 7***

*VICNISS Healthcare Associated Infection Surveillance  
Coordinating Centre*

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# MISSION STATEMENT

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The VICNISS Coordinating Centre (VCC) aims to reduce the burden of healthcare-associated infections on the Victorian community. This is achieved by implementing and supporting a standardised hospital infection surveillance system as a key component of infection control preventative strategies. VICNISS is committed to working in collaborative partnerships with Victorian health services and key stakeholders to achieve this aim.

## PURPOSE AND USE OF THIS MANUAL

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To provide information, definitions, and instructions for hospitals that participate in VICNISS to ensure standardisation of data collection, analysis and reporting procedures.

This manual is based on the National Health Safety Network (NHSN) manual (formerly the National Nosocomial (hospital-acquired) Infections Surveillance (NNIS) system), Centers for Disease Control and Prevention (CDC) in the United States<sup>1</sup>. The information contained has been adapted for Victorian Infection Control personnel as our local system has evolved.

The VICNISS Type 1 Surveillance Manual is intended for use by infection control staff, hospital epidemiologists, and other personnel who are involved in surveillance activities in Victorian public and private hospitals.

Relevant modules to be read in conjunction with SHIINe Software Manual (when available).

## CONTACT DETAILS

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# TABLE OF CONTENTS

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<b>LIST OF TABLES .....</b>	<b>3</b>
<b>SECTION 1: VICNISS – AN OVERVIEW .....</b>	<b>4</b>
1.1. What is VICNISS? .....	4
1.2. Introduction .....	4
1.3. Objectives of VICNISS .....	4
1.4. Activities of the VICNISS Coordinating Centre .....	4
1.5. VICNISS Surveillance Programs .....	5
1.6. VICNISS Surveillance Components .....	5
1.7. VICNISS Data Transfer and Reporting Requirements .....	5
<b>SECTION 2: HEALTHCARE-ASSOCIATED INFECTION SURVEILLANCE .....</b>	<b>7</b>
2.1. What is Surveillance? .....	7
2.2. Why do we do Surveillance? .....	7
2.3. Selecting Surveillance Targets .....	7
2.4. Essential Elements of Surveillance.....	8
2.4.1. Collection of Data .....	8
2.4.2. Post Discharge Surveillance.....	8
2.4.3. Management of Data.....	8
2.4.4. Analysis of Data.....	8
2.4.5. Feedback and Reporting of Data.....	9
<b>SECTION 3: INTERPRETATION OF SURVEILLANCE RESULTS.....</b>	<b>11</b>
3.1. Reporting of Infection Rates .....	11
3.2. Comparison of Rates – Basic Statistical Concepts .....	11
3.2.1. The Mean .....	11
3.2.2. The Median and Other Percentiles.....	11
3.2.3. Risk Stratification .....	11
3.2.4. Comparison of Rates with Aggregated Rates .....	13
3.2.5. The p value.....	13
3.2.6. Confidence Intervals (CI).....	14
3.2.7. Standardised Infection Ratio (SIR).....	15
3.2.8. Risk Stratification and Standardised Infection Ratio for Caesarean Section .....	16
3.2.9. Risk Stratification and Calculation of Rates for ICU/NNL (CLABSI, PLABSI and VAP) .....	18

<b>SECTION 4: VICNISS PARTICIPATION REQUIREMENTS.....</b>	<b>22</b>
4.1. VICNISS Performance Indicators .....	22
4.2. VICNISS Annual Surveillance Plans.....	22
4.3. Key Dates for Data Submission.....	23
<b>SECTION 5: IDENTIFYING HEALTHCARE-ASSOCIATED INFECTIONS (HAI) IN VICNISS .....</b>	<b>24</b>

## LIST OF TABLES

Table 3.1	Determining the Risk Index Category .....	12
Table 3.2	Sample Calculations of SSI Rates for Appendicectomies.....	13
Table 3.3	Comparing SSI Rates for Surgeon A by Procedure with VICNISS Rates .....	15
Table 3.4	Calculation of Expected Numbers of SSIs for Each Category and Standardised Infection Ratios .....	16
Table 3.5	Calculation of Standardised Infection Ratios for Caesarean Sections .....	17
Table 3.6	Example Comparing Hospital A's Device Utilisation Ratios with the Mean of the Aggregate VICNISS Data .....	19
Table 3.7	Example Comparing Hospital A's Device Associated Infection Rates with the Distribution of VICNISS Rates.....	20
Table 3.8	Comparing Hospital A's Device-associated Infection Rates with VICNISS Aggregate Rates using a Standard Statistical Test .....	20
Table 4.1	Examples of Annual Surveillance Plans .....	23

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## SECTION 1: VICNISS – AN OVERVIEW

### 1.1. What is VICNISS?

VICNISS is a healthcare-associated infection (HAI) surveillance system based on the US NHSN system<sup>1</sup>.

### 1.2. Introduction

In 2000, the Victorian Government's infection control plan included establishment of a surveillance system for hospital-acquired infections<sup>2</sup>.

In 2002, the Victorian Department of Health funded the establishment of an independent Coordinating Centre, to provide advice and support for VICNISS.

### 1.3. Objectives of VICNISS

The objectives of VICNISS are:

- To promote a standardised validated approach to HAI surveillance methods.
- To provide aggregated risk-adjusted data on HAIs which enables health services to benchmark against aggregated state and international data.
- To promote the use of evidence based information to permit timely recognition of HAIs for prevention, early intervention and cost containment.
- To improve the way surveillance results are used by individual hospitals and across health services.
- To promote the integration of HAI surveillance (including routine data collection) with strategic planning and continuous quality improvement systems for infection control.
- To promote consumer participation in the development of HAI performance measure reporting.

### 1.4. Activities of the VICNISS Coordinating Centre

In order to meet above objectives the VICNISS Coordinating Centre will:

- Assist hospitals in developing and implementing standardised validated surveillance methods.
- Collect specified surveillance data from health care facilities.
- Analyse and report risk adjusted HAI aggregated data.
- Conduct collaborative research studies to:
  - Describe the epidemiology of emerging infections and pathogens;
  - Assess the importance of potential risk factors;
  - Further characterise healthcare-associated pathogens and resistance mechanisms;
  - Evaluate alternative surveillance and prevention strategies.
- Provide reports on deliverables to all key stakeholders via the VICNISS Advisory Committee.

## 1.5. VICNISS Surveillance Programs

All Victorian public and some private hospitals participate in VICNISS.

There are two main surveillance options, as follows:

### Type 1 Surveillance Program

Based on established NHSN methodology for SSI, ICU/Neonatal (NNL) and outpatient haemodialysis surveillance.

Hospitals of less than 100 beds or low surgical throughput are generally excluded.

This Manual deals exclusively with Type 1 surveillance.

### Type 2 Surveillance Program

For hospitals with <100 acute care beds. Developed and evaluated in consultation with key stakeholders and includes targeted process indicators and other approaches such as reporting of Vancomycin Resistant Enterococci (VRE) and Methicillin Resistant *Staphylococcus aureus* (MRSA). (Refer to the [VICNISS Type 2 Surveillance Manual](#) on the VICNISS website for further information on this program).

## 1.6. VICNISS Surveillance Components

Listed below are the modules available for Type 1 surveillance. Modules may be used singly or simultaneously. Further information (including instructions, standardised surveillance methods, definitions and data collection forms) for each module is available on the VICNISS website.

- [Surgical Site Infection \(SSI\)](#)
- [Central Line Associated Bloodstream Infection \(CLABSI\)](#) (ICU & NNL)
- [Peripheral Line Associated Bloodstream Infection \(PLABSI\)](#) (NNL only)
- [Ventilator Associated Pneumonia \(VAP\)](#) (ICU only)
- [Central Line Insertion Practices \(CLIP\) Adherence Monitoring](#)
- [Staphylococcus aureus Bacteraemia \(SAB\)](#)
- [Clostridium difficile Infection \(CDI\)](#)
- [Haemodialysis Event \(HDE\)](#)
- [Hand Hygiene Initiative \(HH\)](#)
- [Healthcare Worker Influenza Vaccination Compliance](#)

## 1.7. VICNISS Data Transfer and Reporting Requirements

Data transfer may occur via:

- Hard copy of VICNISS surveillance forms (fax, post, or scan to VICNISS); or
- Electronic format (from hospital internal database) using email or other methods to the VCC.
- Online data collection form (web form). Refer to the [Web Based Data Collection Forms User Guide](#) on the VICNISS website.
- Specialised surveillance software (SHIINE) is currently being rolled out to Type 1 hospitals.
- Hand Hygiene data is entered into the [Hand Hygiene Compliance Application](#) (HHCApp).

## References

1. Centers for Disease Control and Prevention. The National Healthcare Safety Network (NHSN) Manual. Patient Safety Component Protocol. 2010 [www.cdc.gov/nhsn/TOC\\_PSCManual.html](http://www.cdc.gov/nhsn/TOC_PSCManual.html) (last accessed Nov 2010).
2. Department of Health, Victoria. Guidelines for infection control strategic management planning - Appendix 1: Victoria's 5 Point Infection Control Strategy. 2000 [www.health.vic.gov.au/infectionprevention/publications/guidelines/appendix\\_1.htm](http://www.health.vic.gov.au/infectionprevention/publications/guidelines/appendix_1.htm).

## **SECTION 2: HEALTHCARE-ASSOCIATED INFECTION SURVEILLANCE**

### **2.1. What is Surveillance?**

Surveillance is the systematic collection, management, analysis, interpretation and reporting of data for use in the planning, implementation and evaluation of health practice. Perhaps the most vital component is the capacity to feedback data to person/s who can undertake effective prevention and control activities.

In a hospital setting, information obtained from surveillance of healthcare-associated infections (HAI) can be extremely important in the context of continuous quality improvement (CQI) as use of objective data is used to improve patient outcomes.

### **2.2. Why do we do Surveillance?**

Surveillance of diseases, conditions or events can provide reliable data on which to base decisions. Surveillance data allows assessment of the size of the problem, trends over time, and can assist with planning and evaluating interventions. A good surveillance program should help to:

- Determine baseline rates of adverse events (including HAI);
- Detect changes in the rates or distribution of these events;
- Facilitate investigation of significantly increased rates of infection;
- Determine the effectiveness of infection control measures;
- Monitor compliance with established hospital practices;
- Evaluate changes in practice; and
- Identify areas where research would be beneficial.

### **2.3. Selecting Surveillance Targets**

In a hospital setting, infection control teams must tailor their surveillance activities to best match resources with priorities and institutional objectives. Elements to be considered when choosing events for surveillance include the specific objectives of the surveillance system, i.e. what exactly do you want to know?

- The frequency of the event;
- The cost or impact of the event;
- The potential for surveillance data to contribute to prevention activities;
- The health needs of the client or patient population; and
- The organisation's mission and strategic goals.

The most important characteristic of any surveillance system is that the data that are collected allow you to answer the question you were asking.

Traditionally, surveillance for healthcare associated infections was often "hospital-wide" surveillance, where data were collected on all identified infections in the facility. This method of surveillance has now largely been overtaken by more targeted surveillance methods that focus on at-risk groups.

## 2.4. Essential Elements of Surveillance

This section describes the basic elements of surveillance of healthcare-associated infections.

### 2.4.1. Collection of Data

The US NHSN definitions are the most comprehensive and widely used definitions for healthcare-associated infections. VICNISS data collection is based on these definitions. **The use and correct application of these definitions is vital if the results of surveillance are to be compared between facilities and internationally.**

To ensure good, reliable data, the information being collected must be well defined and understood by all those involved. Staff collecting data must understand and apply these definitions consistently to ensure that, where an event or person does not meet the definition, they should be excluded.

### 2.4.2. Post Discharge Surveillance

Post discharge surveillance is of increasing concern because of shorter lengths of stay in the acute care inpatient setting. It is estimated that between 12% and 84% of SSIs are detected after discharge. However there is no consensus on which post discharge surveillance methods are the most sensitive, specific and practical. Although there are no standardised methods for this kind of surveillance, development of such systems is becoming increasingly important as without post discharge surveillance a significant percentage of infections may be missed.

Post discharge surveillance is not currently included in VICNISS.

### 2.4.3. Management of Data

Data should be collected, organised and stored in systems that facilitate analysis and reporting. Computerisation can greatly assist with this process. Computerised data should be backed up regularly to reduce chances of losing data.

### 2.4.4. Analysis of Data

Surveillance systems need to incorporate appropriate analyses, often not relying on count data alone, but using methods that take into account the size of the population under study, as well as the time period of the surveillance.

Using **ratios, proportions** and **rates**, rather than raw numbers to describe events often allows for comparisons between different time periods or facilities. When calculating a rate or ratio for healthcare associated infections the denominator (lower portion of a fraction) should closely represent the population at risk of acquiring the infection of interest e.g. total number of patient days, total number of central line days; the numerator (upper portion of a fraction) represents each event (e.g., infection) that occurs during the defined period of interest.

Examples of analyses relevant to healthcare-associated infections:

#### A. Calculation of Infection Rates

The general formula for calculation of infection rates is  $(a/b) \times c$  where

a = the number of infections (**the numerator**)

b = the number in the population at risk (**the denominator**)

c = is a constant and is a multiple of 10.

The resulting rate should be a number greater than or equal to zero. For a proportion,  $c$  is 100, and the result can also be given as a percentage. Usually, for reporting device rates,  $c$  is 1000. The result is reported as a number of infections per 1000 device days.

For example, if in a sample of 120 total knee replacements there are four infections, the rate would be  $4/120 \times 100$  or 3.33 percent. An alternative way to report this rate would be  $4/120 \times 1000$  or a rate of 33.33 infections per 1000 operations.

## **B. Risk Stratification**

Within any population, individuals exhibit variation. These differences may affect an individual's risk of infection.

For example, people with diabetes or obesity may be at a higher risk of infection than people without these conditions. When comparing populations, we often make attempts to adjust for these factors to make the comparisons fairer or more valid.

For further information refer to [Interpretation of Surveillance Results, Risk Stratification](#) (section 3.2.3 below).

## **C. Comparison of Rates**

Comparison of infection rates for different time periods, for different hospitals or, less commonly, between individuals, should only be attempted in the following circumstances:

- Where rates have been calculated on groups stratified according to risk; and
- Where surveillance methods and definitions were uniform and consistently applied; and
- Where the sample size was sufficiently large to calculate a valid estimate of the infection rate (the required sample size depends on what the rate is expected to be, and can be calculated).

### **2.4.5. Feedback and Reporting of Data**

The VICNISS Coordinating Centre (VCC) will analyse the data and report back to facilities within agreed timeframes.

The results of the analysis must be communicated to the persons who need the information and have the power to authorise changes. There is little point in carrying out surveillance if the data are not used to report on rates and to make changes where these are necessary. Regular reporting and feedback is a vital component of a successful surveillance system.

As an example, with regards to VICNISS data, we strongly encourage that surgical site infection (SSI) rates should be fed back to surgeons and surgical teams, central line associated bloodstream infection (CLABSI) rates should be fed back to intensivists and intensive care unit (ICU) staff, surgical antibiotic prophylaxis data should be fed back to surgeons, anaesthetists and surgical teams. Of course, all this data should be provided to Infection Control Committees, Quality Committees, and certainly Executive Management. This feedback should not be just one occasion, but on a regular, routine basis.

Information should be tailored to meet different needs. Executive Management will not necessarily need to know the same information as the surgeons. Simple reports that provide the target audience with the most important information in a couple of minutes are the most effective. This can be in simple graphs or tables. Ask your audience for feedback on the way the data is presented to them, but it is important to remember too much information can be distracting.

Many of these principles are outlined in “Basics of Surgical-Site Infection Surveillance”, Marie-Claude Roy, MD, MS; Trish M Perl, MD, MSc, *Infect Control Hosp Epidemiol* 1997;18:659-668.

Although the VICNISS Coordinating Centre does not have the resources to provide each hospital with individual graphs, we also provide data in Excel format and may be able to provide some tips on how best to present and disseminate your data. Please also refer to our guide on [How to Create Histograms with 95% Confidence Intervals in MS Excel](#) on the VICNISS website.

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## SECTION 3: INTERPRETATION OF SURVEILLANCE RESULTS

### 3.1. Reporting of Infection Rates

When considering infection rates, questions that may be asked include:

- How does a hospital's infection rate compare with the aggregated rate of others?
- How have these rates changed over time?

Collection of valid surveillance data and calculation of infection rates may facilitate investigation of abnormally high rates and implementation of interventions. However, comparisons of infection rates must be made with caution and an understanding of the relevant assumptions and limitations.

### 3.2. Comparison of Rates – Basic Statistical Concepts

#### 3.2.1. The Mean

The mean is usually described as the arithmetic average of a set of numbers. It is the sum of the numbers divided by the total sample size of the group of numbers.

It can be useful to compare your hospital's ratios and rates with the VICNISS mean ratios and rates, which are calculated from all of the hospital data combined. However, the problem with using a mean is that as an average, they can be "distorted" by one or two outliers, i.e. numbers that are very high or very low compared with the rest of the values.

For example, consider the following set of ten numbers: 100,101,103,103,105,110,112,114,115 and 766. This set of values has a mean of 162.6. This mean is quite high when you consider that most of the numbers (9/10) are 115 or less. To overcome this problem, sometimes better measures to use are the median or other percentiles.

#### 3.2.2. The Median and Other Percentiles

Percentiles provide information about the distribution of a group of numbers. For example, consider the set of numbers 1,1,2,2,2,4,4,4,5,5,7,7,8,9,9,12,13,14,14 and 19. It is fairly obvious that this set of 20 numbers, all between 0 and 20, are not evenly distributed. Ten of the numbers are less than 6. Most of the numbers are less than 10. Only five numbers are between 10 and 20.

For this particular set of numbers, half of the numbers are less than 6 and half of the numbers are greater than 6. Thus, 6 is known as the 50<sup>th</sup> percentile for these numbers. *The 50<sup>th</sup> percentile is also known as the median.* Other percentiles, however, can also be used. The 25<sup>th</sup> percentile of this set of numbers is 3, as a quarter of the numbers are less than 3 and three quarters of them are greater than 3. Commonly used percentiles include 10, 25, 50, 75 and 90. Knowing the percentiles for a set of numbers provides a great deal more information about the distribution of the numbers than just the mean.

#### 3.2.3. Risk Stratification

When comparing infection rates it is vital that any comparisons made are valid and useful. One of the major considerations is that rates should be calculated based on groups of patients with a similar infection risk.

**Stratification** is a technique to control for differences in distribution of risk by subdividing a larger population into groups with similar attributes. For surveillance of some types of healthcare-associated infections, a method of achieving this is through use of a risk index. Individuals are given a score

based on their estimated risk of infection relative to other individuals. Comparisons are then made between infection rates based on groups of individuals in the same risk category, who therefore have been deemed to have a similar level of risk.

An example of risk stratification is SSI surveillance patients who are stratified according to VICNISS Procedure Groups (combinations of clinically similar operative procedures). Within the group, patients are further stratified using the basic NHSN risk index (see below). Using groups of operative procedures (based on NHSN) and the NHSN risk index allows for comparisons of rates with international data collected using the same methodology.

### Basic NHSN Risk Index

The basic NHSN risk index is patterned after the Surgical Wound Index (SWI) developed during the SENIC project and is used in the NHSN and VICNISS programs.<sup>1,2</sup> This SSI Risk Index is calculated by allocating one point to the patient for each of the following:

1. ASA classification of  $\geq 3$ .
2. Contaminated or Dirty/Infected wound classification.
3. Operation lasting more than t hours where t is the approximate 75<sup>th</sup> percentile of the duration of surgery for that particular operative procedure. That is, 75% of the operations for that procedure were shorter than t hours and 25% were longer than t hours. (VICNISS will use US duration of surgery data until there is sufficient local data, and this will allow comparison with US and international infection rates).

This concept is illustrated in Table 3.1. The resulting risk index is a number between 0 and 3 allocated to each patient.

**Table 3.1 Determining the Risk Index Category**

	ASA Score	Wound Class	Operation > t Hours	Final Risk Index
Patient 1	4 <sup>(1 point)</sup>	Dirty <sup>(1 point)</sup>	Yes <sup>(1 point)</sup>	1+1+1=3
Patient 2	2 <sup>(0 points)</sup>	Clean <sup>(0 points)</sup>	No <sup>(0 points)</sup>	0+0+0= 0
Patient 3	2 <sup>(0 points)</sup>	Clean-contaminated <sup>(0 points)</sup>	Yes <sup>(1 point)</sup>	0+0+1=1

### Modified NHSN Risk Index

For **cholecystectomy** and **colon surgery**, the use of a laparoscope has influenced the risk of developing SSI. Use of a laparoscope to perform the surgery has been incorporated into the modified index by subtracting 1 from the patient's risk index if a laparoscope was used for their surgery. The result is a 5 level index, M (for minus 1), 0, 1, 2 or 3 for these operations.

For **appendicectomy** and **gastric surgery**, the laparoscope only influenced the risk where the patient's basic risk index was 0. Therefore, for these operations the index includes 0-No where a laparoscope **was not** used on a patient with basic risk index 0 and 0-Yes where a laparoscope **was** used on a patient with basic risk index 0. All other patients are classified as risk index 1, 2 or 3 and use of the laparoscope is not taken into account.

In addition, sometimes patients in two adjacent risk categories are combined for comparison and reporting purposes for a particular procedure if it has been demonstrated that the risk is not statistically different. For example, patients undergoing cardiac surgery with risk index 2 or 3 have in

the past been found to have risks that are not significantly different, and these rates are often reported together in one category designated ‘2,3’.

### SSI Rates Stratified by Risk Index

Rates are calculated using the following formula: *Note that rates are expressed per 100 procedures.*

$$\text{Rate} = \frac{\text{number of SSI in patients in risk index category } r \text{ who had a particular VICNISS operative procedure}}{\text{number of patients in risk category } r \text{ who had that procedure}} \times 100$$

**Table 3.2 Sample Calculations of SSI Rates for Appendicectomies**

Risk Category	Number of SSI	Number of procedures	SSI rate (per 100 procedures)
0-No	1	50	1/50 X 100 = <b>2.0</b>
0-Yes	0	110	0/110 X 100 = <b>0.0</b>
1	2	94	2/94 X 100 = <b>2.1</b>
2	2	76	2/76 X 100 = <b>2.6</b>
3	2	42	2/42 X 100 = <b>4.8</b>

#### 3.2.4. Comparison of Rates with Aggregated Rates

Once risk stratified infection rates are calculated, an individual hospital’s rates may be compared with the VICNISS aggregate rates. Any two infection rates may also be compared using a statistical test. For example, a particular Surgeon’s SSI rate may be compared with the VICNISS or hospital aggregate.

Most statistical tests for comparing rates or proportions do so by assuming that the rates are equal, and test the difference between the rates to see how likely it is that the difference is due to chance, or whether there may be a “real” or statistically significant difference. Output from these tests normally includes a p value and confidence intervals (see below).

#### 3.2.5. The p value

The p value represents the probability that the difference between two rates (or other sets of values) has arisen solely by chance.

Chance can play a part because an infection rate is calculated based on a particular set of data, for example all ICU infections occurring at Hospital A between the beginning of January and the end of March 2011. This set of data is a subset, or sample, of all of the ICU infection data theoretically possible to collect. Thus, the rate calculated from this sample data is an estimate of the “true” infection rate. If, for example, data is collected between June and August in the same year and the infection rate is calculated again, the rates may be expected to be similar but not identical. In the same way a hospital’s infection rate may be expected to be similar but not identical to the VICNISS aggregate infection (mean) rate.

The p value examines the probability that a difference between two rates has arisen by chance. If this probability is high, it is likely that any difference between the rates is due to chance.

If however, this probability is low (**usually < 5% or 0.05 is used as a cut off point**, but this is arbitrary) then it is usually concluded that the difference in rates is unlikely to be due to chance alone, and represents a “real” or significant difference. The difference between the two rates is considered to be **statistically significant**. It is important to recognise that statistical significance does not necessarily imply clinical or practical significance. For example, a rate that is significantly higher than the aggregate rate does not necessarily imply that there is an infection control problem that needs to be addressed. The p value should only ever be used as a guide.

A reason for caution when using p values is that the p value is not always straightforward to interpret. Two factors affect the p value: the magnitude of the difference between the two rates, and the sample size. This means that for **large** sample sizes, even a **small** difference between two rates may be statistically significant, whereas for **small** sample sizes a **large** difference between two rates may not be statistically significant.

To overcome some of this difficulty in interpreting p values, confidence intervals may also be calculated to help evaluate the role of chance in the results, that is, the observed difference between the two rates.

### **3.2.6. Confidence Intervals (CI)**

A confidence interval for an estimate (for example an infection rate estimate) represents the range within which the true value could be expected to lie with a certain degree of assurance. For example, 95% confidence intervals for an infection rate represent the range of values within which the true rate could be expected to lie 95% of the time.

The confidence interval provides additional information to the p value in that the width of the confidence interval indicates the amount of variability in the estimate and thus reflects the effect of sample size. A small sample size will result in an estimate with wide confidence intervals, indicating it is ‘less certain’ that the estimate is close to the true value of the rate.

Table 3.3 shows sample results from comparing SSI rates for an individual surgeon with VICNISS aggregate rates.

**Table 3.3 Comparing SSI Rates for Surgeon A by Procedure with VICNISS Rates**

Procedure	Risk Index Category	No. of SSI	No. of Operations	SSI Rate (Surgeon A)*	VICNISS Rate*	p-value	95% CIs for Surgeon A's Rate
<b>Cardiac Surgery</b>	0	0	2	0.0			0.00 – 84.19
	1	3	80	3.8	1.7	0.15	0.78 – 10.57
	2,3	1	2	5.0	2.8		1.26 – 98.74
<b>CBGB</b>	0	1	1	10.0	0.7	0.08	0.25 – 44.50
	1	10	230	4.3	3.5	0.30	2.10 – 7.85
	2		120	4.2	5.8	0.29	1.37 – 9.46
	3	5	60	8.3	17.5	0.11	2.76 – 18.39
<b>Total</b>		25	522	4.8	---	---	3.12 – 6.99

\* Rates are per 100 procedures

Note that the p value reveals no significant differences between Surgeon A's rates and the VICNISS rate, however half of his/her rates are higher than the VICNISS rate. It is also apparent that his/her surgical volume is relatively low in all but risk category 1 for the CBGB group. This is reflected in the wide confidence intervals for the corresponding rate estimate. For example, for cardiac surgery, for risk index 2,3 the sample size is only 2 operations and this is reflected in the wide confidence intervals which are 1.26 – 98.74. Note also that the confidence intervals for most of Surgeon A's rates encompass the VICNISS rate, meaning that Surgeon A's rate could be closer to the VICNISS rate given a larger sample size.

The procedures for comparing a hospital's rates with the VICNISS aggregate rates are identical to those described here.

### 3.2.7. Standardised Infection Ratio (SIR)

A table of comparisons such as that described above provides the most specific method of comparing Surgeon A's rates against the VICNISS aggregates. However another measure known as the Standardised Infection Ratio (SIR), which is a risk adjusted measurement of Surgeon A's **overall** experience may also be helpful.

Surgeon A's patients had 25 surgical site infections from 522 operations for an overall (crude) rate of 4.8%. Given the types of procedures performed and the distribution of Surgeon A's patients by risk index, the number of infections which could have been expected to occur among Surgeon A's patients can be calculated using the VICNISS rates.

For example, for CBGB risk index 1, Surgeon A performed 230 operations. If his/her rate was the same as the VICNISS rate (3.5 per 100 operations) we would have expected Surgeon A to have 8.05 infections in this group, calculated as follows:

$$230 \times 3.5\% = 8.05$$

This calculation is performed for each risk index category and each surgery type (see Table 3.4).

**Table 3.4 Calculation of Expected Numbers of SSIs for Each Category and Standardised Infection Ratios**

Procedure	Risk Index Category	Observed No. of SSI	No. of Operations	SSI Rate (Surgeon A)	VICNISS Rate	Expected number of SSI	Standardised Infection Ratio (SIR)
Cardiac	0	0	2	0.0			---
Cardiac	1	3	80	3.8	1.7		<b>2.20</b>
Cardiac	2,3	1	2	5.0	2.8	1.10	<b>0.90</b>
CBGB	0	1	1	10.0	0.7	0.07	<b>14.30</b>
CBGB	1	10	230	4.3	3.5	8.05	<b>1.20</b>
CBGB	2		120	4.2	5.8	6.96	<b>0.71</b>
CBGB	3	5	60	8.3	17.5	10.50	<b>0.48</b>
<b>Total</b>		25	522	4.8	---	28.05	<b>0.89</b>

Once the expected numbers have been calculated for **ALL** risk index categories, the expected and observed numbers in each category are totalled and the SIR is calculated as follows:

$$SIR = \frac{\text{Observed number of SSIs}}{\text{Expected number of SSIs}} = \frac{25}{28.05} = 0.89 \text{ for Surgeon A}$$

Although a SIR has been calculated for each risk index category, the SIR for all of Surgeon A's procedures gives a single, easy to interpret measure of his overall experience.

**If the SIR is less than 1, it means that Surgeon A had, overall, less infections than were expected according to the aggregate rates. If, however, Surgeon A's SIR exceeds 1, then more infections occurred than were expected.** Since the SIR incorporates the type of operations performed and the distribution of patients by risk index it can be used for comparison. Care should be exercised when making comparisons, however, as the risk index is limited and does not control for all possible factors which may contribute to an individual surgeon's or hospital's rates.

### 3.2.8. Risk Stratification and Standardised Infection Ratio for Caesarean Section

Basic risk stratification as used by NHSN and VICNISS consists of a point system. Each patient is assigned a level of risk according to their ASA score, wound class and duration of operation. However, for several procedures where this risk stratification has been shown to be less effective in predicting infection risk, a different approach is taken.

This approach involves applying statistical techniques to the results of a large study in order to identify which risk factors are predictive of infection risk and the relative contribution each risk factor makes to the final risk. These analyses have been carried out by NHSN and the results are applied to the Victorian data.

For incisional SSI following caesarean sections the risk factors which were shown to be significant were the patient's body mass index (BMI), estimated blood loss, age, ASA score and duration of labour.

The result of the analysis is a model that allows, for each patient, calculation of a **probability** of that patient acquiring a healthcare associated infection. The probabilities are then used to calculate an expected number of infections for the particular group of patients under surveillance and this is compared with the actual number of infections that occurred.

The most important difference with this sort of risk stratification is that it does not result in a rate for infection that can be compared with an aggregate rate, but in a **standardised infection ratio (SIR)**. The SIR is calculated as follows:

$$SIR = \frac{\text{Observed number of infections}}{\text{Expected number of infections}}$$

A SIR of >1 means that more infections were detected than would have been expected, whereas a SIR of <1 means that less infections were detected than were expected.

**Table 3.5 Calculation of Standardised Infection Ratios for Caesarean Sections**

Patient no	BMI	Estimated blood loss (ml)	Age	ASA	Duration of labour (hours)	Incisional SSI	Probability of Incisional SSI (calculated using model)
1	25	489	29	0	12	No	<b>0.095</b>
2	27	678	33	0	10	No	<b>0.073</b>
3	32	800	28	1	8	<b>Yes</b>	<b>0.129</b>
4	24	567	34	0	14	No	<b>0.068</b>
5	35	450	22	1	9	No	<b>0.14</b>
6	29	200	25	0	10	No	<b>0.07</b>

It can be seen in Table 3.5 that the observed number of infections is 1. The expected number of infections is calculated by adding the probabilities for each patient = 0.575.

The SIR =  $1/0.575 = 1.74$

### 3.2.9. Risk Stratification and Calculation of Rates for ICU/NNL (CLABSI, PLABSI and VAP)

#### Risk Stratification

VICNISS reports ICU data by Category 1A hospitals and 'Other':

##### ICU – Category 1A

- St Vincent's Hospital, St Vincent's Health
- The Royal Melbourne Hospital, Melbourne Health
- Monash Medical Centre, Southern Health
- The Alfred, Bayside Health
- Austin Hospital, Austin Health
- Geelong Hospital, Barwon Health
  
- Epworth Richmond
- Melbourne Private Hospital

##### ICU – Other

- Ballarat Base Hospital, Ballarat Health Services
- Bendigo Hospital, Bendigo Health Care Group
- Box Hill Hospital, Eastern Health
- Maroondah Hospital, Eastern Health
- Dandenong Hospital, Southern Health
- Shepparton Campus, Goulburn Valley Health
- Latrobe Regional Hospital
- Frankston Hospital, Peninsula Health
- Warrnambool Hospital, South West Healthcare
- Northern Hospital, Northern Health
- Wangaratta Hospital, Northeast Health
- Western Hospital, Western Health
  
- St John of God Hospital Geelong
- St John of God Hospital Bendigo
- Epworth Freemasons
- Epworth Eastern

##### NNL

- Mercy Hospital for Women
- Royal Women's Hospital
- Royal Children's Hospital
- Monash Medical Centre, Southern Health

#### Calculation of ICU Rates

From data collected in the ICU (and NNL) surveillance module three basic types of calculations can be carried out.

**A. Device utilisation ratios** are a measure of device use per patient days in the ICU. The use of certain devices plays an important role in determining the risk of infection. Device utilisation ratios for individual hospitals can be calculated and compared with the aggregate (mean) ratio and the distribution of all VICNISS hospital ratios. The following formulas are used to calculate device utilisation ratios:

$$\begin{aligned} \text{Central line utilisation ratio} &= \frac{\text{number of central line days}}{\text{number of patient days}} \\ \text{Peripheral line only utilisation ratio} &= \frac{\text{number of peripheral line only days}}{\text{number of patient days}} \\ \text{Ventilator utilisation ratio} &= \frac{\text{number of ventilator days}}{\text{number of patient days}} \\ \text{Overall device utilisation ratio} &= \frac{\text{number of central line days} + \text{number of ventilator days}}{\text{number of patient days}} \end{aligned}$$

Table 3.6 is an example of the comparison of a particular hospital's device utilisation ratios with the VICNISS aggregate ratios. Hospital A's device utilisation ratios have been calculated and can be directly compared with the **mean** and **percentiles** of the VICNISS aggregate device utilisation ratios.

**Table 3.6 Example Comparing Hospital A's Device Utilisation Ratios with the Mean of the Aggregate VICNISS Data**

	Hospital A Device Utilisation Ratio	VICNISS Aggregate Device Utilisation (Mean) Ratio
Central Line Utilisation	0.78	0.80
Ventilator Utilisation	0.60	0.47

In the example above, Hospital A's central line utilisation ratio is slightly below the mean whereas the ventilator utilisation is higher than the mean for the VICNISS aggregate device utilisation ratios.

**B. Device associated infection rates** are calculated using the number of device days (or patient days) as the denominator in order to adjust for the risk associated with exposure to the device and allow for more valid comparisons. Rates are normally reported as infections per 1000 device (eg central line, ventilator) days. Separate infection rates are calculated for each type of device related infection. These may then be compared with the VICNISS aggregate rates.

In the US differences are seen in infection rates in major teaching hospital mixed medical/surgical ICUs as compared to other hospitals. When making comparisons between individual hospitals and the VICNISS aggregate rates this issue must be kept in mind for the purposes of interpretation of any observed differences in rates.

The following formulas are used for calculation of the overall device associated infection rate, the central line associated bloodstream infection (CLABSI) rate, the peripheral line associated infection rate (PLABSI) and ventilator associated pneumonia (VAP) infection rate.

$$\text{Overall device infection rate} = \frac{\text{number of infections in patients with devices}}{\text{number of patient days}} \times 1000$$

$$\begin{aligned} \text{Central line associated bloodstream infection (CLABSI) rate} &= \frac{\text{number of bloodstream infections (BSI) in patients with central lines}}{\text{number of central line days}} \times 1000 \\ \text{Peripheral line only associated bloodstream infection (PLABSI) rate for infants } \leq 1000\text{gm} &= \frac{\text{number of peripheral line only bloodstream infections (BSI) in infants } \leq 1000\text{gm}}{\text{number of peripheral line only days in infants } \leq 1000\text{gm}} \times 1000 \\ \text{Ventilator associated PNEU rate} &= \frac{\text{number of PNEU in patients who were on a ventilator}}{\text{number of ventilator days}} \times 1000 \end{aligned}$$

**Table 3.7 Example Comparing Hospital A's Device Associated Infection Rates with the Distribution of VICNISS Rates**

	Hospital A's Device Associated Infection Rate*	VICNISS Aggregate (Mean) Infection Rate*
Central line associated bloodstream infection	7.0	6.0
Ventilator associated pneumonia	0.9	5.3

\* Rates are calculated per 1000 device days

In the example shown in Table 3.7, Hospital A's rate for central line associated BSI is 7.0 per 1000 device days. This is higher than the VICNISS aggregate mean infection rate of 6.0.

A further test can be carried out to test whether the difference between two rates is statistically significant. This involves using a standard statistical test to evaluate the difference between the two rates. The results of this test include a p value and confidence intervals. These two elements help to assess whether the difference between the rates is statistically significant.

**Table 3.8 Comparing Hospital A's Device-associated Infection Rates with VICNISS Aggregate Rates using a Standard Statistical Test**

Infection type	Hospital A's device associated infection rate*	VICNISS aggregate device associated infection rate*	p value derived from comparison of rates	95% CI s for Hospital A's rate
Ventilator associated pneumonia	19.4	11.2	0.03	12.8 – 23.6
Central line associated bloodstream infection	6.8	7.4	0.64	4.8 – 8.1

\*Rates are calculated per 1000 device-days.

In the above example, Hospital A appears to have a high ventilator associated pneumonia rate. Is this rate significantly higher than the VICNISS aggregate rate? To address this question a p value for the comparison of the rates and confidence intervals for Hospital A's rate is calculated using a statistical test.

Comparison of the rates for VAP results in a p value of 0.03. This means that the probability that the difference in the rates is due to chance is 0.03. As this is less than 0.05, we conclude that the difference in the rates is a statistically significant result. Examining the confidence intervals for the estimate, the lower 95% confidence interval is 12.8 and the upper one is 23.6. This means that

Hospital A's infection rate is likely to lie within this range in 95 out of 100 samples. These confidence intervals are quite wide, and this may indicate that the sample size (not shown here) from which this rate was calculated was small. Some caution would therefore be indicated in concluding that Hospital A's rate was higher in a meaningful sense, since the true rate for Hospital A might be closer to 12.8 which is not much higher than the VICNISS aggregate rate.

Comparison of the central line associated bloodstream infection rates results in a p value of 0.64. It could be concluded that the difference between Hospital A's rate for BSI and the aggregate rate may have been due to chance and is not statistically significant. Note, however, that the confidence intervals in this case are relatively narrow, and this could be because of a large sample size giving a reliable estimate of Hospital A's rate.

In this type of comparison between two rates two important points should be taken into account:

- Does the p value indicate that the difference is statistically significant?
- Are the confidence intervals narrow, suggesting that the sample size was sufficient to give a good estimate of the rate?

If both of these conditions are satisfied, we can be reasonably sure that there is a difference between the rates, which is not just a result of chance variation.

**C. Average length of stay** is sometimes used as a proxy for infection risk and can be calculated from data collected for the denominator. This is not currently reported by VICNISS.

The formula for calculating average length of stay (ALOS) for a particular month is:

$$\text{ALOS} = \frac{d}{c + \frac{a}{2} - \frac{b}{2}}$$

Where:

a = number of patients in ICU on the first day of the month.

b = number of patients in ICU on the first day of the next month.

c = number of patients admitted to the ICU during this month (calculated from the new arrivals field which is completed daily).

d = number of days spent by all patients in the ICU during this month (calculated from the total number of patients column which is completed daily).

The average length of stay for each month in which ICU surveillance is undertaken can be calculated and compared with the infection rates for the same time period.

## References

1. Haley RW, Quade D, Freeman HE, Bennett JV. The SENIC Project. Study on the efficacy of nosocomial infection control (SENIC Project). Summary of study design. *Am J Epidemiol.* 1980 May;111(5):472-85.
2. Culver DH, Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG, Banerjee SN, Edwards JR, Tolson JS, Henderson TS, et al. Surgical wound infection rates by wound class, operative procedure, and patient risk index. National Nosocomial Infections Surveillance System. *Am J Med.* 1991 Sep 16;91(3B):152S-157S.

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## SECTION 4: VICNISS PARTICIPATION REQUIREMENTS

### 4.1. VICNISS Performance Indicators

Performance indicators are one of the many tools to help answer the question: how do you measure what you are achieving? One definition of a performance indicator is the measurement of the performance of a program expressed as a percentage, index, rate or other comparison which is monitored at regular intervals and is compared to one or more criteria.

The performance indicators for hospitals participating in the VICNISS Type 1 surveillance program are: measured in alignment with the financial year calendar; reviewed annually by the VICNISS Coordinating Centre (VCC) and the Department of Health (the Department) and; are endorsed by the VICNISS Advisory Committee (VAC).

The VICNISS [Type 1 Performance Indicators](#) are set out on the VICNISS website. These outline the defined set of surveillance activities and data quality indicators that hospitals are required to perform and achieve. These include the HAI surveillance activities set out in the [Victorian Health Service Performance Monitoring Framework](#). A health service's performance is analysed quarterly by the VCC according to these indicators. The VCC provides a report to the Quality, Safety and Patient Experience Branch at the Department detailing each hospital's performance.

VICNISS data compliance is a Key Performance Indicator (KPI) in the Statement of Priorities (SOP). The Statement of Priorities is an agreement between the minister and hospital boards on key deliverables and performance priorities for the year, including KPIs. Each month, performance against targets agreed in the Statement of Priorities is summarised in the Integrated Performance Report (IPR). This report, which is for limited distribution to the Chief Executive Officer and board chair, gives a summary of the health service performance.

The infection control data compliance KPI aims to improve the quality of infection control reporting by requiring health services to be fully compliant in their data submission to the VCC.

**If a hospital is unable to undertake the surveillance activities as listed in the Performance Indicator document** for any period of time, formal notification to the VCC is required by completing the form [Notice of Inability to Undertake VICNISS Surveillance Activities](#) on the VICNISS website. This notification needs to be signed by the Infection Control Coordinator and the Infection Control Executive Sponsor. This information will then be forwarded to the Department.

### 4.2. VICNISS Annual Surveillance Plans

Surveillance Plans are **due annually on the 1<sup>st</sup> June**, for the following financial year. Annual Surveillance Plan forms are on the VICNISS website in both [Word](#) and [PDF](#) formats. Contact the VCC if you have any inquiries regarding the Surveillance Plans.

When formulating a surveillance plan you should consider the following points:

- [Performance Indicators](#) for hospital's participating in Type 1 Surveillance (Also refer to [section 4.1](#) above).
- Changing priorities at hospitals may prompt changes to the initial Surveillance Plan. The VICNISS Coordinating Centre (VCC) should be informed of any changes as soon as practicable (Refer to section 4.1 above).
- Surveillance components are collected for a minimum of 3 consecutive months, preferably in the same quarter.

- The Annual Surveillance Plan should meet the individual requirements of the hospital. When developing a surveillance plan for your facility the following key questions should be addressed:
  - *What are the priorities for healthcare-associated infection surveillance?*
  - *How will the data be used?*
  - *What patients should be included?*
    - Certain high-risk patients.
    - Certain operative procedures or patients exposed to high-risk procedures.
    - Patients in certain areas of the hospital.
  - *What kinds of data are needed?*
    - Data primarily on infections and their characteristics.
    - Data on the populations who are at risk.
    - Data that will permit the calculation of infection rates by risk index.
    - Data that will permit the calculation of device-associated infection rates.
    - What time period should the data cover to provide useful information.
  - *What resources are required?*
    - Personnel (surveillance, clerical, data processing, other department).
    - Data sources, including both laboratory and patients records
    - Information technology.

**Table 4.1 Examples of Annual Surveillance Plans**

*Example 1 CORRECT: Surveillance plan of different procedure groups/ICU*

Modules / SSI Procedures	Financial Year: / (Please mark Months as appropriate below)											
	J	A	S	O	N	D	J	F	M	A	M	J
ICU - CLABSI	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
APPY	✓	✓	✓									
CARD												
CBGB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

*Example 2 INCORRECT: APPY should be 3 consecutive months, preferably in the same quarter*

Modules / SSI Procdeures	Financial Year: / (Please mark Months as appropriate below)											
	J	A	S	O	N	D	J	F	M	A	M	J
ICU - CLABSI	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
APPY	✓		✓	✓								
CARD												
CBGB												

### 4.3. Key Dates for Data Submission

Hospitals are required to submit surveillance data each quarter. Dates for data submission to the VICNISS Coordinating Centre can be obtained from [Key Dates for Data and Reports](#) on the VICNISS website.

## SECTION 5: IDENTIFYING HEALTHCARE-ASSOCIATED INFECTIONS (HAI) IN VICNISS

Any infection reported to VICNISS must meet the definition of a VICNISS healthcare-associated infection (HAI), that is, a localised or systemic condition resulting from adverse reaction to the presence of an infectious agent(s) or its toxin(s).

There must be no evidence that the infection was present or incubating at the time of hospital admission. *Exception:* CDI and SAB module when the infection may have existed prior to admission, this is then reported accordingly e.g. community associated.

Clinical evidence may be derived from direct observation of the infection site or review of information in the patient chart or other clinical records.

For certain infection sites, a physician's or surgeon's diagnosis of infection derived from direct observation during a surgical operation, endoscopic examination, or other diagnostic studies or from clinical judgment may be an acceptable criterion for a VICNISS infection, unless there is compelling evidence to the contrary. NOTE: Physician's diagnosis of pneumonia alone is not an acceptable criterion for ventilator associated pneumonia.

The following special considerations are important when identifying HAIs:

- Infections occurring in infants that result from passage through the birth canal are considered HAIs.
- The following infections are not considered healthcare-associated:
  - Infections associated with complications or extensions of infections already present on admission, unless a change in pathogen or symptoms strongly suggests the acquisition of a new infection.
  - Infections in infants that have been acquired transplacentally (e.g., herpes simplex, toxoplasmosis, rubella, cytomegalovirus, or syphilis) and become evident  $\leq$  48 hours after birth.
  - Reactivation of a latent infection (e.g., herpes zoster [shingles], herpes simplex, syphilis, or tuberculosis).
- The following conditions are not infections:
  - Colonisation, which means the presence of microorganisms on skin, on mucous membranes in open wounds, or in excretions or secretions but are not causing adverse clinical signs or symptoms.
  - Inflammation that results from tissue response to injury or stimulation by noninfectious agents, such as chemicals.

Before a HAI is reported to VICNISS, the person performing surveillance must decide that the clinical, laboratory, and other diagnostic information gathered on the patient satisfy the criteria for a particular HAI. To assist surveillance personnel in making these decisions consistently, each module in this manual contains a listing of specific infection sites used in the module and the criteria for determining the presence of an infection at each of those sites. The definitions used in this manual are the only criteria that should be used when identifying and reporting VICNISS events. Whenever possible, generally accepted criteria are used; however, where clear consensus is lacking, the criteria are based on the best information available, and, in some cases, somewhat arbitrary decisions.

### Reference

1. Centers for Disease Control and Prevention. The National Healthcare Safety Network (NHSN) Manual. Patient Safety Component Protocol. 2010 [www.cdc.gov/nhsn/TOC\\_PSCManual.html](http://www.cdc.gov/nhsn/TOC_PSCManual.html) (last accessed Nov 2010)